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ABSTRACT

This document presents the content standards for mathematics in Arkansas. These standards are organized into five strands: (1) number sense, properties, and operations; (2) geometry and spatial sense; (3) measurement; (4) data analysis, statistics, and probability; and (5) patterns, algebra, and functions. Each of these strands is subdivided into a series of lists defining what is expected of students in grades K-4, 5-8, and 9-12. A glossary and sample scenarios are also included. (KHR)

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ED 469 091

Revised Mathematics Curriculum Framework

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STRAND: NUMBER SENSE, PROPERTIES, AND OPERATIONS CONTENT STANDARD 1 The student will communicate an understanding of the properties of numbers and operations (add, subtract, multiply, divide). STUDENT LEARNING EXPECTATIONS GRADES K-4	***Assessment Options and Possibilities***
NPO.1.1. **Demonstrate number sense (concepts of counting, grouping, and place value) using manipulatives.**	1. S, O, PE
NPO.1.2. Develop meaning for the operations (add, subtract, multiply, and divide) by modeling and discussing a variety of problem situations.	2. O, D, W
NPO.1.3. **Apply and master counting, grouping, place value, and estimation.**	3. S, T, PE
NPO.1.4. **Solve problems using terminology and symbols of operations (add, subtract, multiply, and divide).**	4. S, T, W
NPO.1.5. **Demonstrate competency of operations (add, subtract, multiply and divide) using mental math and technology.**	5. S, T, PE
NPO.1.6. **Use manipulatives to demonstrate and compare rational numbers/fractions (e.g., find simple parts of a whole).**	6. S, O, D
NPO.1.7. **Communicate understanding of number sense, properties, and operations through journal writing, creating problems, constructing mathematical sentences, etc.**	7. S, T, W
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND: NUMBER SENSE, PROPERTIES, AND OPERATIONS CONTENT STANDARD 2 The student will demonstrate and apply knowledge of numbers and numerical relationships to real-world situations. STUDENT LEARNING EXPECTATIONS GRADES K-4 NPO.2.1. **Represent numbers and operations (add, subtract, multiply, and divide) in a variety of forms using manipulatives, symbols, and graphs (pictographs, etc.).** NPO.2.2. **Apply elementary number theory (skip counting, patterns, number series, odd and even numbers, multiples, fractions, etc.).** NPO.2.3. **Apply computation (add, subtract, multiply, and divide) and estimation to real-world problems.** NPO.2.4. **Use mental math, manipulatives, and technology to solve problems.** NPO.2.5. Describe and compare quantities by using concrete and real-world models of fractions. **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** *1. S, T, D* *2. S, T, PE* *3. S, T, W* *4. S, T, PR* *5. D, E, S*

STRAND: GEOMETRY AND SPATIAL SENSE CONTENT STANDARD 1 The student will demonstrate, construct, communicate, and apply the properties of geometric shapes and spatial sense to connect geometry with problem solving situations. STUDENT LEARNING EXPECTATIONS GRADES K-4 GS.1.1. **Sort, classify, and construct geometric shapes/figures and objects using a variety of manipulatives.** GS.1.2. **Describe, model, draw, construct, compare and classify shapes in one, two and three dimensions.** GS.1.3. **Determine the relationship between shapes/figures using congruence and similarity, and using transformations (flips, slides, and rotations).** GS.1.4. **Predict and determine the results of combining, dividing, and subdividing shapes/figures.** GS.1.5. **Demonstrate spatial awareness (positional relationship, size, direction, area, volume, etc.).** GS.1.6. **Use manipulatives and technology to demonstrate geometric concepts (positional relationship, size, direction, area, volume, etc.).** GS.1.7. **Demonstrate geometric and spatial sense through written and oral communication (e.g., draw and describe a color cube model using isometric dot paper).** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* 1. S, T, D 2. S, T, D 3. S, T, O 4. S, PR, 5. S, D, O 6. S, T, D 7. S, T, W

STRAND: GEOMETRY AND SPATIAL SENSE CONTENT STANDARD 2 The student will solve problems that connect geometric applications to other topics in mathematics and other fields. STUDENT LEARNING EXPECTATIONS GRADES K-4 GS.2.1. **Estimate and measure the size of geometric figures/shapes in the real world (length, width, perimeter, area, volume, etc.)** GS.2.2. **Construct and explain geometric patterns using concrete and pictorial models with one or more attributes (shape, size, etc.)** GS.2.3. **Use manipulatives and technology to solve problems involving perimeter, area, volume, etc.** GS.2.4. **Illustrate geometric concepts through written and oral communication. (e.g., "I am a rectangular house. My windows are squares. My door is a rectangle. My roof is a triangle.")** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** 1. S, PE, LJ 2. S, D, PR 3. S, PE, T 4. S, T, W

STRAND: MEASUREMENT CONTENT STANDARD 1 The student will use measurement attributes (length, capacity, weight, mass, area, volume, time, money, temperature, scale and angle) to describe and compare mathematical and real-world objects. STUDENT LEARNING EXPECTATIONS GRADES K-4 M.1.1. **Demonstrate and apply the concept of comparison (large, small, long, short, etc.) according to given attributes (length, capacity, weight, mass, etc.).** M.1.2. **Select, demonstrate, and defend the use of appropriate units of measure.** M.1.3. **Convert from one measurement to another within the same system (feet to yards, centimeters to meters, etc.).** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** 1. S, O, T 2. S,T, W, S 3. S, D, T, O

STRAND: MEASUREMENT CONTENT STANDARD 2 The student will demonstrate the appropriate use of measuring instruments. STUDENT LEARNING EXPECTATIONS GRADES K-4	*Assessment Options and Possibilities*
M.2.1. **Select and use appropriate standard (inches, feet), non-standard (paper clip, thumbnail), and metric (centimeter, meter) measuring instruments (e.g., rulers, scales, measuring tape, yard stick, meter stick, thermometer, etc.).**	1. S, D, C,T,
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND: MEASUREMENT CONTENT STANDARD 3 The student will apply measurement concepts to solve problems inside and outside the field of mathematics. STUDENT LEARNING EXPECTATIONS GRADES K-4	*Assessment Options and Possibilities*
M.3.1. **Estimate and measure quantities such as weight, length, area, volume, money, time, and temperature.**	1. S, D, LJ, C
M.3.2. **Solve problems using measuring instruments and technology.**	2. S, T, W
M.3.3. **Pose problems using customary (inches, feet, etc.), non-standard (paper clip, thumbnail, etc.), and metric measurements (centimeters, meters, etc.) in real-world situations.**	3. S, PR, W, T
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition, D: demonstration; LJ: log/journal; W: writing.	

STRAND: DATA ANALYSIS, STATISTICS AND PROBABILITY	*Assessment Options and Possibilities*
CONTENT STANDARD 1 The student will perform the steps that comprise data analysis, from gathering information to communicating results.	
STUDENT LEARNING EXPECTATIONS GRADES K-4	
DSP.1.1. Utilize the scientific method for data analysis.	
DSP.1.1.A. Identify the purpose (problem statement) for data collection.	1. PE, PR, W
DSP.1.1.B. Make a prediction about the final results of data collected.	2. S, PR, PE, W
DSP.1.1.C. Collect and organize data (tables, graphs, etc.).	
DSP.1.1.D. Analyze and interpret data (prediction, inference, conclusion, etc.).	
DSP.1.1.E. Display data using appropriate bar graphs, line graphs, tables, pie graphs, etc., with and without technology.	
DSP.1.2. **Explain the results of data collection using oral and written communication.**	
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 2 The student will use probability models to perform experiments and simulations. DSP.2.1. **Predict the results of data collection and demonstrate the concept of chance through the use of manipulatives. (e.g., What is the probability of drawing one red marble from a bag of multicolored marbles?)** DSP.2.2. **Record the results of data collection with a variety of formats that could include charts, graphs, tables, technology, using oral and/or written communication.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	1. S, D, O, LJ, S 2. S, PR, E, LJ

STRAND: DATA ANALYSIS, STATISTICS AND PROBABILITY	*Assessment Options and Possibilities*
CONTENT STANDARD 3 The student will apply probability and statistical concepts in problem-solving and decision-making situations.	
STUDENT LEARNING EXPECTATIONS GRADES K-4	
DSP.3.1. **Predict results, analyze data, and find out why some results are more likely, less likely, or equally likely.**	
DSP.3.2. **Make a true statement based on a simple concept of average (median, mean, mode and range) for a small sample size.**	
DSP.3.3. Use the tools of technology to assist in gathering, organizing, and presenting information.	1. S, PE, LJ 2. S, LJ, T, W
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	3. PR, E, W

STRAND: PATTERNS, ALGEBRA AND FUNCTIONS CONTENT STANDARD 1 The student will use the language/symbols of algebra to represent patterns and functions. GRADES K-4 PAF1.1. **Sort and classify a wide variety of materials.** PAF1.2. **Describe, extend, and create a wide variety of patterns using concrete models.** PAF1.3. **Demonstrate equality (=) and inequality (>,<) using manipulatives and symbols.** PAF1.4. **Demonstrate the beginning concept of a variable. (Use boxes, letters, or other symbols to stand for any number or object in simple situations, with or without concrete material, such as 6 + __ = 8 or 3 + B = 4, etc.).** PAF1.5. **Express mathematical relationships in one and two dimensions. (Length x Width = Area, L x W = A, etc.)** PAF1.6. **Use oral and/ or written communication to interpret created patterns.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* 1. S, D, O, C 2. S, O, PE, C 3. S, D, O, T 4. S, T, D 5. S, T, PE 6. S, T, PE, W

STRAND: NUMBER SENSE, PROPERTIES, AND OPERATIONS CONTENT STANDARD 1 The student will communicate an understanding of the properties of numbers and operations (add, subtract, multiply, divide). 5-8 NPO.1.1. **Identify numerical patterns (e.g., prime numbers, squares, exponents) and verify results (e.g., by continuing the pattern).** NPO.1.2. **Expand number sense through the use of mental computation, calculators/technology, and written and verbal communication.(e.g., powers of ten, factoring, greatest common factors, least common Multiples.)** NPO.1.3. **Represent numbers and operations in a variety of equivalent forms (including models, tree diagrams, and symbols).** NPO.1.4. **Consistently demonstrate competence with rational number computation (add, subtract, multiply, divide) with and without manipulatives and technology.** NPO.1.5. **Communicate knowledge of elementary number theory concepts (e.g., primes, factors, multiples, divisibility rules) through classroom interaction and written responses (e.g., tests, journals).** NPO.1.6. **Identify, with/without the aid of technology, irrational numbers and locate irrational numbers relative to other numbers (for example the square root of 2 is between 1 and 2, pi is between 3 and 4).** Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** 1. S, T,PE,W 2. S, W, PE, T 3. S, PE, T, W 4. S, D,T,PE 5. S, W,T,E 6. S, D,O

STRAND: NUMBER SENSE, PROPERTIES, AND OPERATIONS CONTENT STANDARD 2 The student will demonstrate and apply knowledge of numbers and numerical relationships to real-world situations. 5-8 NPO.2.1. **Use estimation to check the reasonableness of computation in application problems.** NPO.2.2. **Develop strategies for comparing quantities using ratios and proportions (e.g., fractions, rates, unit rates, percents, scales) with use of manipulatives and technology.** NPO.2.3. **Determine the most appropriate notational representation of a number for the given problem (for example fractions vs. decimals, scientific notation).** NPO.2.4. **Explain the relationship of numbers in one and two dimensional graphs (e.g., number lines and coordinate graphs), with and without appropriate technology such as graphing calculators.** NPO.2.5. **Communicate using appropriate vocabulary as it relates to the real number system in real-world situations (e.g., integers, whole, rational, irrational, natural/counting, etc.)** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* 1. S, T, PE, W 2. S, D,T,O 3. S, W, T, PE 4. S, D, T, W 5. S, W,T, PO

STRAND: GEOMETRY AND SPATIAL SENSE	*Assessment Options and Possibilities*
Content Standard 1 The student will demonstrate, construct, communicate, and apply the properties of geometric shapes and spatial sense to connect geometry with problem solving situations. 5-8 GS.1.1. **Identify, draw, describe, classify, and compare geometric figures and their relationships in one, two, and three dimensions (from points to *polyhedra*) with physical materials.** GS.1.2. **Apply geometric properties and formulas (e.g., triangles have 180 degrees, opposite sides of rectangles are equal, Pythagorean theorem) to solve problems with and without appropriate technologies.** GS.1.3. **Make predictions based on transformations of geometric figures in problem solving situations (e.g. compare 2 pictures and determine what changes were made i.e. flip, slide, rotation).** GS.1.4. **Establish and apply geometric relationships through informal reasoning (e.g. estimate angle measures)** GS.1.5. **Visualize, model, and represent 3 dimensional objects (e.g., cube models, base plans/nets, building plans, isometric dot paper sketches) to develop and implement problem-solving strategies and verify solutions.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	1. S, T, PE, W 2. S, D, W, T 3. S, L, T, E 4. S, O, T, D 5. S, E, T, PR

STRAND: GEOMETRY AND SPATIAL SENSE CONTENT STANDARD 2 The student will solve problems that connect geometric applications to other topics in mathematics and other fields. 5-8 GS2.1. **Construct geometric models to solve problems (e.g., comparing bridge supports: cylindrical vs. rectangular).** GS2.2. **Investigate geometric properties and use them to describe and explain situations in society and nature (e.g., why doors are rectangular, why honeycombs are hexagonal, why trusses are triangular).** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** 1. S, E,D,T 2. S, W,T, PR

STRAND: MEASUREMENT CONTENT STANDARD 1 The student will use measurement attributes (length, capacity, weight, mass, area, volume, time, money, temperature, scale and angle) to describe and compare mathematical and real-world objects.	***Assessment Options and Possibilities***
5-8	
M1.1. **Use estimation to check the reasonableness of measurements obtained from use of various instruments (including angle measures).**	1. S, PE, T, O
M.1.2. **Estimate, calculate and compare the one, two and three-dimensional features of objects in metric, customary and non-standard units of measure.**	2. S, D, T, O
M.1.3. **Convert from one measurement to another within the same system (customary or metric)**	3. S, PE, T, O
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND: MEASUREMENT CONTENT STANDARD 2 The student will demonstrate the appropriate use of measuring instruments. 5-8 M.2.1. **Select appropriate units and tools (metric, customary and non-standard) to measure to the required degree of accuracy.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* S, D,T,PR

STRAND 3: MEASUREMENT CONTENT STANDARD 3 The student will apply measurement concepts to solve problems inside and outside the field of mathematics. 5-8	*Assessment Options and Possibilities*
M.3.1. **Develop and use procedures to solve measurement problems using one, two, and three dimensions.**	1. S, W,T,D
M.3.2. **Using manipulatives and technology, develop the concepts of rate of change (mph, interest, tax rates, commissions, utility rates) and indirect measurements (height of an object, width of a river).**	2. S, PE,T,O
M.3.3. **Construct scale drawings (using various tools) and/or build 3-D models to represent real- world problems and situations.**	3. S, PR, E,T
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 1 The student will perform the steps that comprise data analysis, from gathering information to communicating results. 5-8 DSP.1.1. **Actively and systematically collect, organize and describe data using technology when appropriate.** DSP.1.2. **Construct, read and interpret tables, charts and graphs (including stem-and-leaf, histogram, bar graph, pie graph, box and whiskers, line graph, scatter plots) with and without technology.** DSP.1.3. **Based on analysis of central tendencies (mean, median, mode, range) make predictions and inferences (e.g., interpolate from within graphs and extrapolate by extending graphs) from the data set with and without technology.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* 1. S, W, PE, T 2. S, PR, W, D 3. S, D, T, W

STRAND: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 2 The student will use probability models to perform experiments and simulations. 5-8	*Assessment Options and Possibilities*
DSP.2.1. Conduct experiments or simulations, with and without technology, to model situations and construct *sample spaces.*	1. LJ, PE, PR,
DSP.2.2. **Make predictions based on experimental and theoretical probabilities.**	2. S, W, T, O
DSP.2.3. **Use a probability model for comparing experimental results with theoretical expectations.**	
DSP.2.4. **Interpret experimental and theoretical probabilities to determine whether outcomes are equally likely or biased.**	3. S, E, O, W
	4. S, W,T
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 3 The student will apply probability and statistical concepts in problem-solving and decision-making situations. 5-8 DSP.3.1. **Evaluate arguments that are based on statistical data.** DSP.3.2. **Make inferences and convincing arguments based on statistics with and without technology.** DSP.3.3. **Model the use of probability and statistical methods in decision making using technology presentation materials (e.g., LCD, graphing calculators, spreadsheets, etc.).** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* 1. S, W, T, PE 2. S, O, T, D 3. S, E, PR, D

STRAND 5: PATTERNS, ALGEBRA AND FUNCTIONS CONTENT STANDARD 1 The student will use the language/symbols of algebra to represent patterns and functions. 5-8	*Assessment Options and Possibilities*
PAF.1.1. **Represent arithmetic as algebra (change 25 = ___ + 13 to 25 = m + 13).**	
PAF.1.2. **Through the use of manipulatives and computer technology, develop the concepts of variables, expressions, and equations (algebra tiles, two color counters, graphing calculators, balance scale model, etc.).**	1. S, PE, D, T
PAF.1.3. **Analyze and represent (through calculator use) situations and number patterns with tables, graphs, and equations (e.g., identifying linear, exponential, and quadratic patterns).**	2. S, D,O,L
PAF.1.4. **Summarize and pose problems/situations relating to the algebraic relationships, patterns, and functions discovered through explorations.**	3. S, O,D,E
	4. S, W, PO, T
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

Strand 5 PATTERNS, ALGEBRA AND FUNCTIONS Content Standard 2 The student will use algebraic concepts to model, to solve, and to test solutions of mathematical and real-world problems. 5-8 PAF.2.1. **Conduct informal investigations (with technology) for analyzing, representing, interpreting, and generalizing functional relationships (e.g., distance and time) to develop explanations or predictions about outcomes of actual situations.** PAF.2.2. **Identify variables and relationships and translate them into mathematical statements or other mathematics representations to construct a model (e.g., converting from graphs, tables, words, and expressions).** PAF.2.3. **Write and solve equations and inequalities (using manipulatives and technology).** PAF.2.4. **Communicate in written and verbal form a verification of the solution and the process used to obtain the solution.** PAF.2.5. **Use a calculator to display, to determine, and to make inferences from linear relationships in slope-intercept form.**	1. S, PE, W, PR 2. S, E, W, T 3. S, T, PE, O 4. S, W,D, PO 5. S, O,D, T

STRAND: NUMBER SENSE, PROPERTIES, AND OPERATIONS	*Assessment Options and Possibilities*
CONTENT STANDARD 1 The student will communicate an understanding of the properties of numbers and operations (add, subtract, multiply, and divide).	
GRADES 9-12	
NPO.1.1. **Represent numbers in a variety of equivalent forms. (e.g., fraction, decimal, percent, scientific notation, powers and roots)**	1. S, T, W
NPO.1.2. **Make estimates appropriate to a given situation.**	
NPO.1.3. **Verify results and determine the reasonableness of solutions.**	
NPO.1.4. **Solve problems involving real numbers both with and without technology (e.g., scientific/ graphing calculator or computer).**	2, S,O,PE
NPO.1.5. **Use the properties of the real number system to solve problems (e.g., commutative, associative, distributive, and law of exponents)**	3. S, W,O
NPO.1.6. **Demonstrate understanding of relationships between the complex number system and its major subsystems. (natural or counting, whole, integer, rational, irrational, imaginary)**	4. S,T,O,D
<u>Assessment Legend</u>: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	5. S,T,PE,D
	6. S,T,W,O

STRAND: NUMBER SENSE, PROPERTIES, AND OPERATIONS CONTENT STANDARD 2 The student will demonstrate and apply knowledge of numbers and numerical relationships to real-world situations. 9-12	***Assessment Options and Possibilities***
NPO.2.1. **Select and use appropriate problem solving methods (e.g., solve a simpler problem, write an equation, make a table or graph, draw a picture) and tools (e.g., calculator, computer, manipulatives, pencil and paper, model)**	1. S,T,O,D
NPO.2.2. **Demonstrate competency of roots by estimating square roots to the nearest tenth and using a calculator to compute decimal approximations of radicals.**	
NPO.2.3. **Apply ratios and proportional reasoning in a variety of situations (e.g., part-whole relationships, expansions and contractions)**	2. S, O,D,L
	3. S,T,E
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 2: GEOMETRY AND SPATIAL SENSE	*Assessment Options and Possibilities*
CONTENT STANDARD 1 The student will demonstrate, construct, communicate, and apply the properties of geometric shapes and spatial sense to connect geometry with problem solving situations.	
STUDENT LEARNING EXPECTATIONS	
9-12	
GS.1.1. **Describe, visualize, draw, construct and communicate ideas about geometric figures in one, two, and three dimensions.**	1. S, PR,E,W
GS.1.2. **Investigate and predict results of combining, subdividing and changing shapes of geometric figures in relation to perimeter, area and volume.**	2. S, D, L, T
GS.1.3. **Find and analyze relationships among geometric figures using transformations in the coordinate systems. (e.g., reflections, translations, rotations, and dilations)**	3. S, E, PR, O
GS.1.4. **Describe the intersection of two or more geometric figures geometrically (empty set, point, line, plane) and algebraically (systems of equations).**	4. S, D, T, E
GS.1.5. **Classify figures in terms of geometric relationships and informally apply these relationships. (e.g., congruence, symmetry, similarity, self-similarity)**	5. S, T, L, D
GS.1.6. **Apply geometric and trigonometric right triangle relationships.**	6. S,T, PE
GS.1.7. **Establish and explain relationships involving geometric concepts by using informal induction and deductive reasoning.**	7. S, W, T
GS.1.8. Use computer programs and graphing calculators to investigate geometric concepts and communicate the findings.	8. D, O, W
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 2: GEOMETRY AND SPATIAL SENSE CONTENT STANDARD 2 The student will solve problems that connect geometric applications to other topics in mathematics and other fields. STUDENT LEARNING EXPECTATIONS	*Assessment Options and Possibilities*
9-12	
GS.2.1. **Solve real-world and mathematical problems using geometric models (e.g., maximizing and minimizing area and volume).**	S, D,O,T
GS.2.2. **Solve problems using coordinate geometry (e.g., distance between points, midpoint, verifying properties of polygons, parallel/perpendicular lines).**	S, T,W,E
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 3: MEASUREMENT CONTENT STANDARD 1 The student will use measurement attributes (length, capacity, weight, mass, area, volume, time, money, temperature, scale and angle) to describe and compare mathematical and real-world objects. STUDENT LEARNING EXPECTATIONS	*Assessment Options and Possibilities*
9-12	
M.1.1. **Describe the effect on perimeter, area, and volume when dimensions of a geometric object are changed.**	
M.1.2. **Solve problems dealing with changes in length, width, height, radius, diameter, perimeter, area, and volume.**	1. STW 2. STD
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 3: MEASUREMENT CONTENT STANDARD 2 The student will demonstrate the appropriate use of measuring instruments. STUDENT LEARNING EXPECTATIONS 9-12 M.2.1. **Select and use measurement instruments found in the workplace (e.g., Calipers, distance meter, scales, measuring tapes).** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** S, D,O,PE

STRAND 3 CONTENT STANDARD 3 The student will apply measurement concepts to solve problems inside and outside the field of mathematics. STUDENT LEARNING EXPECTATIONS	*Assessment Options and Possibilities*
9-12 M.3.1. **Apply measurement formulas to solve problems. (Perimeter, area, volume)** M.3.2. **Use appropriate techniques to measure quantities in order to achieve specified degrees of precision, accuracy, and error/tolerance.** M.3.3. **Use technology to solve problems. (computers, graphing calculators, Calculator Based Laboratory)** M.3.4. **Apply the concepts of rate of change (mph, interest, tax rates, commissions, utility rates) and indirect measurements (height of an object, width of a river).** M.3.5. **Make and use scale drawings.**	1. S, E,T,D 2. S, T,O,D 3. S. D,PE,O, 4. S, PJ,T,O 5. S. D, PR, PF
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 4: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 1 The student will perform the steps that comprise data analysis, from gathering information to communicating results. 9-12 DSP.1.1. **Collect, organize, analyze and display data through the use of tables, charts and graphs (e.g., line plot, stem-and-leaf, histogram, box-and-whisker plots).** DSP.1.2. **Read, interpret, and make predictions using tables and graphs with the aid of appropriate technology.** DSP.1.3. **Recognize and distinguish between valid or misleading use of statistics in our society.** DSP.1.4. **Describe measures of central tendency and dispersion in real-world situations.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	*Assessment Options and Possibilities* 1. S, E,T,W 2. S, L,D 3. S, PF,E,O 4. S, W,PE,T

STRAND 4: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 2 The student will use probability models to perform experiments and simulations. STUDENT LEARNING EXPECTATIONS 9-12	*Assessment Options and Possibilities*
DSP.1.1. **Design a probability experiment to study a problem and communicate the results.**	
DSP.1.2. **Use counting techniques to determine the number of ways an event can occur.**	1. S. PJ,D,W,
DSP.1.3. **Determine probability of a simple event.**	2. S, D,T,O
DSP.1.4. **Use technology to generate, organize, and display data.**	3. T,PE,O 4. S, O,E,D
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 4: DATA ANALYSIS, STATISTICS AND PROBABILITY CONTENT STANDARD 3 The student will apply probability and statistical concepts in problem-solving and decision-making situations. 9-12	*Assessment Options and Possibilities*
DSP.3.1. **Choose a model that best fits a set of data.**	1. S, D,O,T
DSP.3.2. **Apply the basic concepts of probability to real-world situations.**	2. S, PR, W, D
DSP.3.3. **Design statistical experiments to study a problem and communicate the results.**	3. S, D, W, PJ
DSP.3.4. **Use technology to model data, determine probability and to aid in decision making.**	4. S, T,E,O
Assessment Legend: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	

STRAND 5: PATTERNS, ALGEBRA AND FUNCTIONS CONTENT STANDARD 1 The student will use the language/symbols of algebra to represent patterns and functions. 9-12 PAF.1.1. Model and analyze real-world situations by using patterns and functions. PAF.1.2. Use open sentences, equations, absolute value, algebra tiles, inequalities, absolute value inequalities, number lines, rectangular coordinate systems and matrices as representational tools. PAF.1.3. Use appropriate notation and terminology to describe functions and their properties. **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** 1. S,O,T,E 2. S, T, D, O 3. S, T, D, W

STRAND 5: PATTERNS, ALGEBRA AND FUNCTIONS CONTENT STANDARD 2 The student will use algebraic concepts to model, to solve, and to test solutions of mathematical and real-world problems. 9-12 PAF.2.1. **Use equations, absolute value equations, inequalities, absolute value inequalities, and systems of equations and inequalities to solve mathematical and real-world problems.** PAF.2.2. **Use mathematical reasoning to make conjectures and to justify conclusions.** PAF.2.3. **Solve equations with real and complex roots using a variety of algebraic and graphical methods and using appropriate tools.** PAF.2.4. **Use approximation in problem solving and in assessing reasonableness of solutions.** PAF.2.5. **Apply function concepts to model, graph and deal with real-world situations.** PAF.2.6. **Use technology to develop conceptual understanding and solve problems. (e.g., examine the effects of changing *parameters* on the graphs of functions)** PAF.2.7. **Add, subtract, multiply, and divide polynomials and solve polynomial equations by factoring and graphing.** **Assessment Legend**: S: statewide; T: teacher made tests; PO: portfolio; PR: project; C: checklist; O: observation; PE: performance; E: exhibition; D: demonstration; LJ: log/journal; W: writing.	***Assessment Options and Possibilities*** 1. S, T, W, D 2. S, LJ, D, T 3. S, T,D,E, 4. S. O,W,D 5. S, D,O,E 6. S. W,D,E 7. S, T, D

GLOSSARY

Absolute value: The distance of a number from zero on the number line.

Absolute value inequality: Inequalities involving absolute values.

Abstract: Theoretical; opposite of concrete

Accuracy: Exactness; correctness

Algebra: A generalization of arithmetic in which symbols represent members of a specified set of numbers and are related by operations that hold for all numbers in the set.

Algebra tiles: Manipulatives used to teach the concepts of multiplying polynomials and factoring.

Analyze data: To separate the outcome into parts, for examination and interpretation.

Angle: A plane figure formed by two rays having a common endpoint.

Approximation: A reasonable estimate for a point of intersection for a system of equations.

Area: The amount of space in square units needed to cover a surface.

Associative property: If three or more numbers are added or multiplied, the numbers can be regrouped without changing the results. (e.g. 4+(6+5)=(4+6)+5, 4x(6x5)=(4x6)x5, etc.)

Attributes: A quality, property, or characteristic that describes an item or a person. (e.g. color, size, thickness, shape, etc.)

Balance scale model: A method of teaching the solving of equations.

Bar graph: A means of displaying statistical information in which horizontal or vertical bars are used to compare quantities.

Base plans: See net.

Biased sample: When a sample is not representative of the population from which it is taken.

Box and whiskers: Organization of data distribution represented by a rectangular-shaped graph that shows the minimum, first quartile, median, third quartile, and maximum values.

Building plans: Floor plans for a building

Calculator Based Laboratory (CBL): Laboratory experiments performed with graphing calculators and a data collecting unit.

Calipers: Instruments used to measure internal and external dimensions.

Capacity: The amount of liquid or dry ingredients a container can hold.

Centimeter: A unit of length equal to 1/100 of a meter or 0.3937 inch.

Central tendencies: A single number that is used to describe a set of numbers. (e.g. , mean, median, mode, etc.)

Chance: The abstract nature shared by unexpected, random, or unpredictable events.

Checklist: A list of items that can be marked or checked as items are completed.

Classify: To arrange according to class or category.

Color cube model: A shape/mode formed with cubes of various colors.

Commissions: Allowances to a salesman or agent for his services, usually a percentage of his total sales.

Commutative property: If two numbers are added or multiplied, the operations can be done in any order. (e.g., $4x5=5x4$, $4+5=5+4$, etc.)

Compare: To examine two numbers to determine which is larger.

Compass: An instrument used draw circles and arcs and to transfer measurements.

Complex number system: The complex numbers consist of all sums $a + bi$, where a and b are real numbers and $i = \sqrt{-1}$.

Complex roots: The complex that would form the solution(s) of an equation to be $f(x) = 0$.

Computer programs: A plan for the machine to follow in the solution of a problem.

Conclusion: A decision reached after examining and interpreting data.

Concrete: Any physical object that can be touched, grouped, measured, and rearranged.

Congruent: Figures whose size and shapes are the same.

Conjectures: Guesses or conclusions based on assumed or known knowledge but without proof.

Coordinate geometry: The use of algebra to find relationships between the line segments that form geometric figures.

Coordinate graphs/systems: In a plane pr space, any method of representing points by numbers.

Customary units of measure: Commonly used units of measure (e.g., pound, inch, points, etc.)

Cylindrical: An object shaped like a cylinder or can.

Data analysis: A process of deriving information from data.

Decimals: Numbers written using the 0, 1, 2, 3, 4, 5,, 6, 7, 8. 9. (e.g. 1.03, 0.59, etc.)

Deductive reasoning: The process of reasoning logically from clearly stated hypotheses to a conclusion. (e.g., Thinking as a detective, two-column proofs, etc.)

Degree of accuracy/precision: The extent of numerical measure of its closeness to the true value for which it stands. (e.g. Measure to nearest 1/16 of an inch would allow 1/32 of an inch more or less.

Diameter: A line segment passing through the center of a circle and having endpoints on the circle.

Dilations: Transformations producing similar, but not necessarily congruent figures.

Distance meter: An instrument used to measure distance.

Distributive property: A property of numbers illustrated by $3 \times (5+4) = (3 \times 5)+(3 \times 4)$

Divisibility rules: Rules determining whether a can be divided by another number and have a remainder of zero.

Elementary number theory: Skip counting, patterns, number series, odd and even numbers, multiples, fractions, etc.

Empty set: A set with no elements or members.

Equality: The state of being equal.

Equally likely: Outcomes of an experiment that have the same probability of happening.

Equations: Mathematical sentences containing an equal sign.

Estimation: The approximation of an answer or measurement.

Exhibition: A public display (e.g. posters, charts, etc.)

Experiments: Trials or tests; a procedure used to test a theory.

Exponents: A number showing how many times the base is used as a factor. (e.g., 2^3, the exponent is 3)

Expressions: Variable combined with numbers and operations.

Extend/extending graphs: To spread, stretch, or enlarge a graph for further study.

Extrapolate: To extend and estimate data based on given information.

Factors: Any numbers multiplied by another number to produce a product.

Flips: A transformation resulting in the one-to-one mapping of a figure when reflected over a line.

Formulas: Specific equations giving rules for relationships between quantities.

Fractions: Quotients of two quantities. (e.g., 3/4, 10/11, etc.)

Functions: A relation in which each member of the domain is paired with one, and only one, member of the range.

Geometric concepts: Positional relationship, size, direction, area, volume, etc.

Graphing Calculator: A calculator with the ability to create and display a graph given various information.

Graphs of functions: A pictorial way to display a function.

Hexagonal: A polygon with six sides.

Histogram: A graph, similar to a bar graph, used to display statistical information.

i: A symbol for $\sqrt{-1}$.

Imaginary numbers: A number of the form bi, where b is a real number.

Indirect measurements: The act of calculating measures without actually measuring the item (e.g., Finding the height of a tree using the shadow cast by the tree).

Inductive reasoning: Reasoning from the particular to the general.

Inequality: A mathematical statement that one quantity is less than (<) or greater than (>) another.

Inference: Reasoning from data, premises, graphs, and incomplete and inconsistent sources to form sensible conclusions.

Integers: The set of whole numbers and their opposites.

Interest: Amount paid for the use of money.

Interpolate: To interpret and estimate data between given values.

Interpret data: Translate collected information.

Interpreting: Translating

Intersection: The point or points common to two or more geometric figures.

Irrational numbers: Real numbers that cannot be expressed in the form a/b (a fraction), where a and b are integers.

Isometric dot paper: Paper with dots that are equally spaced.

Journal writing: The daily recording of occurrences.

Linear relationships: Relationships in which a number grows by a fixed amount.

Line graph: A means of displaying statistical information by connecting graphs of ordered pairs to show changes in quantities.

Lines: A set of points (x,y) that satisfy the equation $ax + by + c = 0$, where a and b are not both zero; A thin, continuous mark.

Log/journal: A record of performance

Manipulatives: Hands-on/concrete materials that are used to develop a concept.

Mass: The amount of matter an object contains

Matrices: Ordered tables or listings of numerical data.

Maximizing area and volume: Enlarging the area or volume of a figure without changing the size.

Mean: The sum of a set of numbers divided by the number of numbers in that set.

Measuring instruments: Tools used to measure various attributes (e.g., ruler, balance, protractor, thermometer, etc.).

Median: In a list of data ordered from least to greatest or greatest to least, the middle number or the average of the middle two numbers.

Mental math: Computation without the aid of any tools, including pencil and paper.

Meter: The basic unit of length in the metric system.

Minimizing area and volume: Decreasing the area or volume without changing the size

Misleading use of statistics: Using statistics to draw misleading conclusions.

Mode: In a list of data, the number or item occurring most frequently.

Modeling: Setting an example to be followed.

Mph: miles per hour

Multiples: The products of any number and another whole number.

Natural numbers: One of the numbers 1, 2, 3, 4,... also called counting numbers.

Nets: Blueprints for a many-sided figure (polyhedra); Flat shapes that can be folded and joined to form a solid figure.

Non-standard measuring instruments: Non-customary measuring tools (e.g., paperclips, straw, chains, etc.)

Notation: A system of figures or symbols used to represent numbers, quantities, etc.

Notational representation: To rewrite using symbols

Number line: A line on which points are identified by numbers. The number is called the coordinate of the point. On a number line, the points are evenly spaced, and the magnitude of the number increases as you move from left to right.

Number sense: The ability of the learner to make logical connections between new information and previously acquired knowledge to understand the meanings, relationships, and magnitudes of numbers and common measurements.

Number theory: Concepts of numbers such as prime, composite, squares, factors, and multiples.

Observation: The act of paying attention or noticing.

One dimension: Having only one spatial extent (e.g. line and point).

Open sentences: Sentences that allow for various acceptable answers and for multiple approaches to an effective solution.

Operations: Basic arithmetic procedures and how they relate to one another (addition, subtraction, multiplication, and division).

Oral communication: Spoken exchange of thoughts

Parameters: When the position of a point in an x-y plane is described in terms of a third variable, the third variable is a parameter.

Part-whole relationships: The concept of fractions being part of a whole.

Patterns: Repeated sequences

Percents: Numbers representing a hundredth part of a whole (e.g., 10% = 10/100, 90% = 90/100, etc.).

Performance: The act of fulfilling a duty or obligation.

Perimeter: The distance around a plane figure.

Physical materials: Materials that are representative of real life: Manipulatives

Pictorial models: Pictures of items used in modeling.

Place value: Value of a digit depending on its position in a number (e.g., 435 means 4 hundreds, 3 tens, and 5 ones or units).

Plane: A flat surface having no boundaries.

Point: A specific location in space.

Polynomial: Any expression of the form $a_nx^n+a_{n-1}x^{n-1}+...+a_1x+a_0$, where n is a nonnegative integer and a_0 , ...,a_n are constant coefficients (e.g. $x^2 + x + 1$).

Polynomial Equations: An equation of the form P(x) = c, where P(x) is a polynomial and c is a constant (e.g. $x^2 + x + 1 = 0$).

Portfolio: A compilation of papers, drawings etc.

Pose problems: Formulate and present problems.

Positional relationships: Next to, behind, in front of, adjacent, opposite, etc.

Powers: Numbers that can be expressed using exponents (e.g. 2^3, 4^6, etc.).

Predict: Mathematical guess made from accumulated data.

Prime numbers: A whole number greater than one having exactly two distinct factors, one and the number itself.

Probability and statistics concepts: The application of the mathematical theory of notions of chance, or random, phenomena.

Project: An undertaking requiring a concerted effort (e.g. report, research paper, sculpture, etc.).

Properties: Rules in mathematics (e.g. associative, commutative, distributive, etc.).

Proportions: Two equivalent ratios set up t make a mathematical sentence (e.g., □ = x/4, 3/4 = 9/12, etc.).

Protractor: An instrument for measuring angles.

Pythagorean theorem: In a right triangle, the sum of the squares of the length of the legs is equal to the square of the length of the hypotenuse ($a^2 + b^2 = c^2$).

Radius: A line segment having one endpoint at the center of the circle and the other endpoint on the circle.

Range (statistics): The difference between the greatest and least numbers in a set of numerical data.

Rate: A ratio of two measurements having different units; percent.

Rate of change: The amount of increase or decrease of a function.

Ratio: A comparison of two numbers, represented in one of the following ways: 2 to 5, 2 out of 5, 2:5, or 2/5.

Rational numbers: A number in the form of an integer/integer, there the denominator does not equal zero. All integers are rational numbers.

Real number system: The set of irrational and rational numbers together.

Real roots: The zeros of an equation that occur at x-intercepts of the graph of the related function.

Rectangles: A parallelogram having four right angles.

Rectangular coordinate system: A system in which a plane is divided into four regions by a horizontal and a vertical number line and the addresses, or coordinates, of points are given by ordered pairs.

Reflections: Mirror images of a figure. Objects stay the same shape but their positions change through a flip.

Representing: Symbolizing; standing for

Rotations: Objects stay the same shape but their positions change through a turn.

Sample size: The number in the representative group.

Sample spaces: The set of all possible outcomes for a situation.

Scale: The numeric ratio used to produce an enlarged or reduced drawing of a picture or an object.

Scale drawings: Pictures that show relative sizes of real objects.

Scales (Balance): A weighing device

Scatter plots: Graphs that show a set of points, each based on paired data.

Scientific method: A process used to comprise data analysis. The steps are: Identify the purpose of data collection; Make a prediction about the final results of data collected; collect and organize data; Analyze and interpret data; Display results.

Scientific notation: A means of expressing a number as a product of a number between one and ten and a power of ten (e.g. $1100 = 1.1 \times 10^3$).

Self-similarity: A figure has self-similarity if a part f the figure viewed at a particular scale resembles a corresponding part viewed at a different scale.

Similar: Figures whose shapes are the same but size may be the same or different.

Simulations: Experiments designed to find an approximation for a theoretical probability.

Skip counting: To count by skipping numbers in a set pattern (e.g. (2,4,6,...),(5,10,15,...), etc.)

Slides: Objects stay the same shape, but their position changes through a horizontal glide, or a combination of these two.

Slope-intercept form: A linear equation in the form y=mx+b, where m is the slope of the graph of the equation and b is the y-intercept.

Sort and classify: Separate and categorize

Spatial sense: The ability of learners to make logical connections about their surroundings and the objects in them.

Square roots: One of two equal factors of a number. Since (-5)(-5) = 25 and (5)(5) =25, □25 = 5 or -5. The principal square root of 25 is 5.

Squares (numeric): The product of a number and itself.

Statewide assessment: Assessment across the state.

Statistical data: Facts collected and arranged to show information.

Stem-and-leaf display: A means of organizing data in which certain digits are used as stems, and the remaining digits are leaves.

Symmetry: The division, with an imaginary line, of a shape into identical parts in such a way that one part appears to be the reflection of the other.

System of equations: Two or more equations in the same variables.

Tables: A display of data, usually arranged in rows and columns.

Tax rates: The percentages at which taxes are charged (e.g., 2% sales tax).

Teacher-made test: An assessment created by the teacher.

Technology: Calculators, interactive graphics programs, spreadsheets, etc.

Theoretical probabilities: Probabilities determined without performing an experiment.

Thermometer: An instrument used to measure temperature.

Three dimensions: Having three spatial extents (e.g. length, width, height, etc.)

Three-dimensional models: Solids (e.g. pyramid, cylinder, sphere, etc.)

Tolerance: The capacity to endure

Transformations: Objects stay the same shape but their position changes through a slide, flip, or turn or a combination of these.

Translations: Transformations that move all points in a plane a fixed distance in a given direction.

Tree diagrams: Diagrams whose branches show the possible outcomes of a probability experiment.

Triangle: A polygon having three sides.

Trigonometric functions: A function that involves a trigonometric ratio.

Two-color counters: Discs with a different color on each of its surfaces. Used as manipulatives to teach integer operations and other mathematical concepts.

Two dimensions: Having two spatial extents (e.g. length and width)

Unit rates: Any fixed amount, quantity, etc., used as a standard.

Units of measure: inches, meters, pounds, grams, etc.

Utility rates: Amount paid for public service, such as gas, electricity, water, or transportation.

Variable: A symbol that can assume different values (e.g., 2 + N = 8, N > 4, etc.).

Various tools: Different tools

Visualize: To form a mental image

Volume: The number of cubic units needed to fill a space.

Whole numbers: The set of natural numbers and zero. 0, 1, 2, 3, ...

Writing: A composition of thoughts into words.

180°: One hundred eighty degrees. The number of degrees in a straight angle or in a semicircle.

Strand 1: Number Sense, Properties, and Operations
Content Standard 2: The student will demonstrate and apply knowledge of numbers and numerical relationships to real-world situations.

Students are being introduced to the concept of multiplication as a form of repetitive addition. As a whole group, the class orally skip counts by twos, fives, and tens. Each student is then given 20 unifix cubes and is asked to make a picture on their desk of 4 + 4. Students are then asked to make a picture or array of 4 + 4 + 4. These pictures are put in number sentences on the student's paper. Students are then asked how many groups of four they have. The teacher guides them to understand that this can be recorded as 3 X 4 instead of 4 + 4 + 4. This process is repeated until students clearly make the transfer from repetitive addition to multiplication.

Student are then asked to start with a clean sheet of paper and unifix cubes in one large group. They are allotted a period of time and each group makes as many multiplication pictures as possible with their 20 cubes. For each picture made, the student records the picture in a number sentence. They become actively competitive as they try to "beat" the classmates. The teacher is circulating around the room to make sure students are making pictures before recording sentences and to correct any misconceptions of arrays.

Strand 1: Number Sense, Properties, and Operations
Content Standard 1: The student will communicate an understanding of the properties of numbers and operations.

At the beginning of the school year, students are involved in learning the value of a digit according to its place in the number. The bulletin board displays groups of units, tens, hundreds using pictures of base ten blocks, and on the chalkboard is a display of a street with houses along that street. Each house represents a place value period of ones, hundreds, and thousands. Students use magnetic numbers to place under each house to "build" numbers. With a partner, they practice writing the number they have created and practice saying the name of the number.

Students are involved in playing place value games with a partner. They have place value mats, base ten blocks, and number cubes. In one game, they take turns rolling the number cube to build their base ten blocks up to one hundred. A second game is to start with a flat, rod, and unit. The object of the game is to clear the mat by rolling the cube and removing the number rolled. Students are learning to make exchanges in each place value to obtain their goals.

Strand 2: Geometry and Spatial Sense
Content Standard 1: The student will demonstrate, construct, communicate, and apply the properties of geometric shapes and spatial sense to connect geometry with problem-solving situations.

In the classroom, three-dimensional models of geometric shapes are available for students to investigate. One group of students is building different patterns by combining pattern blocks. Another group is sorting attribute blocks according to shape, size, and color. The teacher has read the story Grandfather Tang to the class and constructed the pictures from the story on the overhead for students to see as she read. Around the room are displays of student work showing geometric pictures they have made using construction paper tangrams.

Strand 2: Geometry and Spatial Sense
Content Standard 2: The student will solve problems that connect geometric applications to other topics in mathematics and other fields.

On the bulletin board are pictures of architectural applications of geometric shapes, such as the sphere at Epcot Center, the Egyptian Pyramids, the Eiffel Tower, the Sears Tower, etc. Hanging from the ceiling, there are mobiles of geometric shapes and on the walls are posters of the students' classification of the geometric shapes by specified attributes.

Students are sitting in groups of 4 or 5. The teacher is moving from group to group, having each group draw a slip of paper with the name of a geometric shape on it from a container. Each group is to form the chosen shape with their bodies for the remainder of the class to observe and assess for accuracy.

Scissors, glue, markers, magazines, and a sheet of construction paper are provided to each group. Students are to locate an example of how each geometric shape is used in real life. They are to cut the picture out of the magazine and use markers to outline geometric shapes in the picture. The picture is then attached to the construction paper with glue. The student writes the name of the shape under the picture. All the groups combine their pictures to form a geometric shape book.

Strand 3: Measurement
Content Standard 3: The student will apply measurement concepts to solve problems inside and outside the field of mathematics.

The class is involved in counting money and learning to make change. On the interactive bulletin board are large replicas of dollar bills and coins. The students are working in pairs and each pair has a cash tray with one, five, and ten-dollar bills and assorted coins of all denominations. Each student in the pair takes a turn at being the customer and the clerk. On the board, there are three columns: Price; Amount Received; and Change Given. One at a time, the teacher writes the price of an item and the amount of money received for that item. The teacher then circulates about the room to watch the process by which the students are making change. She gives guidelines and suggestions to students who are having difficulty. With the group, the teacher reviews and records the different ways change was given with emphasis on giving correct change and with the best combination of coins and bills as possible. The process continues until students are comfortable with the process and have a clear understanding of making change.

Strand 3: Measurement
Content Standard 2: The student will demonstrate the appropriate use of measuring instruments.

In one area of the classroom, two students are weighing various objects using a balance scale and gram weights. Two other students are measuring the width and height of the windows in the room.

A bulletin board displays different tools used for measuring and abbreviations for both standard and metric measurement.

The students have been involved in group work with measuring weight, length, and volume. They did this in three different sessions by while using appropriate tools for each concept and each group had items to estimate and measure. Students used non-standard means to make an estimate, the estimate was recorded, and students chose the appropriate measuring tool to determine the exact measurement. The exact measurement was recorded and compared to the estimate.

Strand 4: Data Analysis, Statistics and Probability

Content Standard 1: The student will perform the steps that comprise data analysis, from gathering information to communicating results.

In one area of the room, there is a container of attribute blocks with paper and colored markers. Students can sort and graph the blocks according to shape, size, color, etc.

In another part of the room is a container of colored buttons and a container of connecting cubes. The students are sorting the buttons by color. Students get one connecting cube for each colored button. The cubes are connected and placed on the table when they are finished. When the activity is completed the students will state which color appears most often, the least number of times, and how many buttons are there in each color group.

Some students are working at their desks. Each has a pack of M & M's. They are sorting and graphing the numbers of each color of candy found in the bag.

To help students analyze and apply the data collected, the teacher poses the following questions with sample responses. What is your favorite color of M & M's? (Blue, red, green) What is the color with the least number? (Blue, red, green) What color has the largest number? (Yellow or brown) Why would the company put only a few of the favorite colors in each bag? (To get kids to buy more M & M's)

Strand 4: Data Analysis, Statistics and Probability
Content Standard 2 (also addresses 3): The student will use probability models to perform experiments and simulations.

The teacher poses a problem to the students. She has a bag containing five black marbles and three red ones. When the teacher draws a marble from the bag, what are the chances of getting red marble? The teacher puts a chart on the chalkboard to record results as one student at a time comes forward to take a marble from the bag.

In different areas of the room, probability models are set up with materials for recording results. Models include coins to flip and determine heads or tails, spinners with different numerical amounts and number cubes with different numerical amounts.

Students are placed in groups of 3 or 4 and will create games of chance. The class will then participate in the games to celebrate the completion of the objective.

SCENARIOS K-4 MATH

Strand 5: Patterns, Algebra and Functions
Content Standard 1: The student will use the language/symbols of algebra to represent patterns and functions.

In a kindergarten classroom, the students are seated in a circle. The teacher walks behind each student tapping each one on the head as she goes. As she taps, she says, "Duck, Duck, Goose," and repeats that pattern around the circle. The teacher tells the students she will repeat the process but will start with a different student. She asks the students to predict who will be the "Goose" each time. The process is repeated by letting a student walk around the circle, tapping and creating a new pattern.

The teacher then helps the students transfer their knowledge of patterns from one format to another by having the students create the same patterns as "Duck, Duck, Goose," using body motions such as clapping hands, stamping feet, etc.

After students return to their seats they are asked to show their pattern with colored connecting cubes.

Strand 1: Number Sense, Properties, and Operations
Content Standard 1: The student will communicate an understanding of the properties of numbers and operations.

Mrs. Evans wished to assess her students abilities to communicate their knowledge of elementary number theory concepts. She gave the following journal assignment: Using the words factor, multiple, product, and divisible by, write as many sentences as you can about the mathematical statement 4 x 7= 28.

Strand 1: Number Sense, Properties, and Operations
Content Standard 2: The student will demonstrate and apply knowledge of numbers and numerical relationships to real-world situations.

Mrs. Roberts wanted to require her students to develop strategies for comparing quantities using ratios and proportions. She related the story of _____ who, during ancient times, determined the height of Egyptian pyramids using ratio and proportion. Mrs. Roberts asked the class, How did he do it? In small groups her students were to develop a method he might have used. To test their strategies she had them gather materials, go outside, and determine the height of the flagpole.

Real life applications:

- Determining the height of trees for the timber industry.
- Determining house height for painting purposes.
- Nozzle diameter proportional to water pressure for firemen.

Strand 2: Geometry and Spatial Sense
Content Standard 1: The student will demonstrate, construct, communicate, and apply the properties of geometric shapes and spatial sense to connect geometry with problem-solving situations.

Following a unit of geometric study, Mr. Sowder has students make a God s Eye (Ojo de Dios) using string and dowel rods. Then students are to describe in writing the geometric figures and concepts found in their creation.

SCENARIOS 5-8 MATH

Strand 2: Geometry and Spatial Sense
Content Standard 2: The student will solve problems that connect geometric applications to other topics in mathematics and other fields.

Mrs. Koons goal is to increase her students spatial sense. She has her students work with partners to build a cube using polydrons. She then had them unfold their cubes into a two-dimensional net. Each group then traces their net onto chart paper so the class can see the variety of nets. She then poses the questions, Are these nets the only nets possible to build a cube? If not what others are there? Are there nets that do not work? What do the nets that work have in common? Prior to building it, can you decide from looking at a net if it will work?"

Continuing with the above net exercise, Mrs. Koons poses the real world situation of fabricators determining the use of materials when laying out net patterns to be cut from a bulk source. Machinists use sheet metal, box makers use card board, seamstresses use fabric. All must find the most efficient net placement. Using polydrons, she has them determine the best type and placement of nets to get the most cubes from a sheet of poster board.

Strand 3: Measurement
Content Standard 1: The student will use measurement attributes (length, capacity, weight, mass, area, volume, time, money, temperature, scale, and angle) to describe and compare mathematical and real-world objects.

Mr. Smith wanted students to use estimation to predict the measure of angles. He first had students to form a right angle using their thumb and index finger of their hand. He had them show angles greater than 90 degrees and less than 90 degrees. He then asked students to estimate the measure of various angles that he had drawn on a lab sheet by placing an index card at the vertex to represent a 90 degree angle. Once students had completed their estimates, they used protractors to determine the exact measure. Mr. Smith then compared the protractor measure with the estimated measure and discussed strategies students used to check their results.

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SCENARIOS 5-8 MATH

Strand 3: Measurement
Content Standard 2: The student will demonstrate the appropriate use of measuring instruments.

After teaching a unit on metric measurement Mrs. Trowell gave the following test to assess students understanding of the basic

concepts of the metric system and their ability to apply this understanding in real-world problem solving settings.
(Use p.27 from NCTM Addenda book, Measurement in the Middle Grades)

Strand 3: Measurement
Content Standard 3: The student will apply measurement concepts to solve problems inside and outside the field of mathematics.

After completing a unit on ratio and proportion (which included scale drawing), Mrs. Brady decided to assign a project as a part of the unit assessment. She gave students the option of working alone or in groups on the project. Students were asked to choose a room or building, make appropriate measurements, then make a scale drawing. They were then asked to select a scale from which to build a model of their own. After constructing the model, students were then asked to write a summary of all their work, including their research, learning experiences, and obstacles they encountered.

Strand 4: Data Analysis, Statistics and Probability
Content Standard 1: The student will perform the steps that comprise data analysis, from gathering information to communicating results.

Mr. Timms class recorded the calorie intake of each student over the course of a week. Students combined their records to create a set of data. Mr. Timms then put students into small groups and asked them to choose an appropriate way of representing the data. They were required to construct a display using technology and physical materials. The groups were also asked to submit a written interpretation and description of the data. Students then shared their projects with the class.

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SCENARIOS 5-8 MATH

Strand 4: Data Analysis, Statistics and Probability
Content Standard 2: The student will use probability models to perform experiments and simulations.

Mr. Craig asked his students what they thought would happen if he flipped a quarter 100 times. His purpose was to establish that

they already knew that heads and tails were equally likely. He discovered that they felt there was a "fifty-fifty chance" of getting heads. He then discussed "fifty-fifty" as a theoretical probability. The students then conducted an experiment by tossing a coin 100 times. The groups explained their experimental probabilities and how they related to the theoretical probabilities. Mr. Craig led his students to notice the experimental probability grew closer to 50% as each group's results were included. The discussion then progressed to include terms like "equally likely" and "biased outcomes."

Strand 4: Data Analysis, Statistics and Probability
Content Standard 3: The student will apply probability and statistical concepts in problem-solving and decision-making situations.

Ms. Potter's class has been studying statistics. They have looked at all kinds of statistical reports on things such as cigarette smoking, fat consumption, and litter production. Ms. Potter puts her class in groups to pick a topic to analyze. The groups look at scale, mean, median, mode, range, etc. to determine the reliability of those statistical reports and debate their conclusions drawn from the data. (The internet was a great source of statistical data.)

SCENARIOS 5-8 MATH

Strand 5: Patterns, Algebra and Functions
Content Standard 1: The student will use the language/symbols of algebra to represent patterns and functions.

To introduce equations and the fact that both sides of the equal sign must be equivalent, Ms. Robinson uses balance scales and small objects set up in four stations. She begins with a demonstration; there are 9 counters on the left and 3 counters and a paper bag on the right. "What equation does this show?"... 9= 3+p. "What number does "p" represent?"

The students then move through the three remaining stations repeating the same process. She observes the students as they go through the stations to check for understanding or problems.

Strand 5: Patterns, Algebra and Functions
Content Standard 2: The student will use algebraic concepts to model, to solve, and to test solutions of mathematical and real-world problems.

The Tale of Teachers...he who has technology and she who does not.
Mrs. Nix and Mr. Sowder want their students to understand the effects of changing the slope and/or the y-intercept on a linear graph.

Mr. Sowder, using his graphing calculator and overhead attachment, quickly graphs a linear equation, changes the slope then the y-intercept, and shows the three graphs together to demonstrate the visual difference in the graphs by making numerical changes in the equation. The students then use their calculators to graph many different equations with slope and intercept changes. They quickly learn to predict what graphic change will result from equation changes, prior to graphing them.

Mrs. Nix, using an overhead transparency and a ruler, plots points and graphs a linear equation. She then changes the slope of the equation, plots points, and graphs a second line but in a different color. She repeats the process changing the y-intercept and graphs a third line in a third color. They compare the three graphs and then the students use rulers and graph paper to graph an equation themselves. Without technology, these students will spend more time on plotting points and graphing then in determining the physical changes that will occur with slope and intercept changes.

SCENARIOS 9-12 MATH

Strand 2: Geometry and Spatial Sense
Content Standard 1: The student will demonstrate, construct, communicate, and apply the properties of geometric shapes and spatial sense to connect geometry with problem solving situations.

If students were to draw the bisectors of the angles of a square, they would meet in a single point because they are the diagonals. Have students draw a rectangle and construct the bisectors of the four interior angles using a Mira, compass, or paper folding as described in a handout. These four lines intersect in four points. Students should list as many properties of these four points as possible. Students will compare lists and justify the properties on the combined list. If there are any properties of the four points

constructed that are common to each quadrilateral, write the conjecture in if-then form and write a justification for it.

Strand 2: Geometry and Spatial Sense
Content Standard 2: The student will solve problems that connect geometric applications to other topics in mathematics and other fields.

Teacher would provide students with coordinates and ask them to determine the different types of figures they could make. For example, given three coordinates they would use distance and midpoint formulas to determine if the triangle was scalene, equilateral, etc. Given four coordinates they would determine what type of quadrilateral they had. Students would then write an explanation of their conclusions.

Strand 3: Measurement
Content Standard 1: The student will use measurement attributes (length, capacity, weight, mass, area, volume, time, money, temperature, scale and angle) to describe and compare mathematical and real-world objects.

When students enter the room teacher will have a table with different size and shape boxes. Students are asked to estimate surface area and volume of each one. Let each group measure one. Students take calculations and find actual surface area and volume. Students should compare this to their estimates. Give each student in a group a 8.5 by 11 size paper and have them find the dimensions of an open top box that would maximize volume while keeping the surface area constant.

SCENARIOS 9-12 MATH

Strand 3: Measurement
Content Standard 3: The student will apply measurement concepts to solve problems inside and outside the field of mathematics.

When students enter the room they see directions on the board that tell them to pair up, get a stopwatch, and begin timing how long it takes each person to walk 2 meters, 4 meters, 6 meters, 8 meters, and 9 meters. Tape was on the floor for each one of those meter measures. After collecting the data students are to plot their data points on a graph to determine their walking speed. The students must then apply this information to a particular scenario. A tour group wants to determine how far a group of students can hike in one school day to determine if they can take a field trip. The field trip has been planned to hike five miles one way. If they arrive at school

at 8 o□clock and load the bus by 8:15, and drive 30 minutes to the park, can they do the hike and spend 30 minutes for lunch and get back to school by 3 p.m.?

Strand 4: Data Analysis, Statistics and Probability
Content Standard 1: The student will perform the steps that comprise data analysis, from gathering information to communicating results.

Students are divided into groups of 3 or 4. Each group has a calculator-based laboratory (CBL), a graphing calculator, a car or ball, and an inclined plane (board, blocks, books, etc.) Students have an activity sheet that tells them how to conduct the experiment and collect the data from the car (ball) rolling up and down the inclined plane. Students look at the graph, follow the directions on the activity sheet, and find the graph of the equation. Experiment with changing incline of the plane and position of the motion detector to see the effects on the graph.

SCENARIOS 9-12 MATH

Strand 5:Patterns, Algebra and Functions
Content Standard 2: The student will use algebraic concepts to model, to solve, and to test solutions of mathematical and real-world problems.

Students are given this problem.

We are planning on taking a trip to Six Flags in Dallas, Texas. We are going to rent a car to make the trip. The Ace car rental charges $.22 per mile plus a basic charge of $20 per day. The other one charges $.28 per mile plus a daily charge of $15 per day. This trip is 275 miles. You will need the car 3 days. Which car rental agency should you use to spend the least amount of money on transportation?

Students are engaged in conversation with teacher about possible ways to solve the problem. Students try to find a model to fit the situation in groups. Some students will choose to solve the equation using pencil and paper and some will use a graphing calculator. Pose the question if you only take a 150-mile trip would you still use the same agency, why or why not? Students will complete a writing assignment to answer this question.

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